



Water Quality & Treatment / Wastewater Treatment: Studies, Design, Operation / Industrial Wastewater Management

ESVELT ENVIRONMENTAL ENGINEERING

December 8, 1981

Mr. Phil Williams, Environmental Engineer
Kaiser Aluminum and Chemical Corporation
Trentwood Works
P. O. Box 15108
Spokane, Washington 99215

Re: Groundwater quality

Dear Phil:

Thank you for the assignment to review water quality data and issues concerning the Kaiser East Landfill which contains a large deposit of waste dross placed there several years ago. This letter contains my review of an August 1980 report by Sweet, Edwards & Associates, Inc., various memos and data and a discussion of specific issues surrounding the East Landfill and its effect or potential effect on water quality in the Spokane--Rathdrum Aquifer.

A report on Kaiser Aluminum and Chemical Corporation's Trentwood Plant Monitoring Well Data Evaluation, by Sweet, Edwards & Associates, Inc., was published in August 1980. The report presents the results of testing the five KACC groundwater monitoring wells. Figures 4 and 5 appear to show that the aquifer receives flow from the river during a portion of the year (Fall, Figure 4) upstream and south of the plant and discharges to the river downstream (west). During a portion of the year (Spring, Figure 5) the aquifer apparently discharges to the river to the south too. There is a gradient from east to west during both seasons indicating flow beneath the Kaiser plant in a generally westerly direction. An annual 6 to 8 ft. variation in water surface is indicated for test wells near the river (1, 2, and 3) which probably closely approximates the river water surface variation in this reach. If readings within



two months after drilling are ignored, wells 4 and 5 had a relatively lower annual fluctuation in water level. Readings taken in January and February 1981 confirm that the aquifer doesn't fluctuate as much in this vicinity.

The USGS ground water modelling effort produced water surface contours for several periods during 1977 and 1978. The two figures attached show the contours from that study. These figures confirm that seasonal ground water surface elevation changes are much greater near the westerly edge of the Kaiser site than near the easterly edge.

The USGS contour maps also show that the direction of ground water flow can fluctuate. In the vicinity of the East Landfill the flow direction as taken perpendicular to the contour lines appears to range from S 47° W to S 76° W although there is no apparent seasonal consistency. Beneath the rolling mill the flow direction appears to be more consistent, varying from S 61° W to S 77° W. Ground water flow direction west and northwest of KACC appears to be consistently perpendicular to the river. The northern boundary of the aquifer forces the aquifer flow southwesterly here. The granite intrusion west of the river in this vicinity apparently causes the aquifer flow to "squeeze" through a gap northwest of KACC. A significant quantity of water apparently enters the river from the aquifer near KACC Test Wells 1, 2, and 3.

The Sweet, Edwards & Associates' report statements regarding percolation from various areas on the KACC site appear to be justifiable. Percolation is probably seasonal during high precipitation and low evaporation and not during freezeup.

Water quality data presented by Sweet, Edwards & Associates shows a sharp variation in chlorides, especially in Well No. 4. This variation has been experienced again in 1981 and similar variations have been recorded in the KACC production well previously. The production well lies about S 70° W of the East Landfill, about 1500 ft. and Test Well No. 4 lies directly west of the East Landfill only about 400 feet. Figures 25 and 26

of the Spokane County Water Quality Management Plan (208 Study) Cause and Effect Report (attached) show water quality variations in the KACC production well during 1973-74 sampling by the Spokane County Health District and during 1977-78 sampling by the 208 study.

There is little question that high salts concentrations are entering the aquifer from a confined area at the East Landfill. Water quality data from Spokane Industrial Park production wells just east of the KACC site is also presented on Figures 25 and 26 from the Cause and Effect Report. There is very little water quality variation in these wells during the same sampling periods. IP 2 is nearly directly east of the East Landfill only about one-half mile. The generally westerly aquifer flow picks up salts from the East Landfill vicinity and transports them westerly affecting the water quality in Test Well No.4 and the KACC production well.

Water quality data collected by the KACC laboratory during April and May 1980 and during January 1981 showed large increases in Chloride concentrations to occur in Test Well No.4 from 14 to 20 days before a similar large increase in chloride concentration in the Production Well. This indicates that velocity of water in the aquifer is from about 55 to 80 feet per day, approximately what has been reported by the USGS.

The strong concentration peaks of chlorides and other constituents in Test Well 4 and the Eastgate production well apparently are caused by pulses of moisture moving downward through the East Landfill and adjacent alluvium which carries salts to the aquifer. These pulses occur in the early winter after ground saturation but before freezeup and also after spring thaw. A reservoir of salts is contained in the landfill itself and also in the alluvium below the landfill as shown in sampling from Test Well No.7.

Figure 11 in the Sweet, Edwards and Associates report shows chloride levels in the various test wells. That the chloride concentration is consistently higher in Test Well No.1 than in 2 or 3, appears to result from the southwesterly aquifer flow in this area where aquifer water

from north of KACC in the Trentwood area apparently predominates in Wells 2 and 3. Another aspect of Figure 11 is the consistent level of chlorides in Test Well 1 compared with the sharp peaking in concentration in Test Well 4. Concentration peaks are lower but more prolonged in the production well (see Figure 26 from the 208 Cause and Effect Report). Longitudinal dispersion is apparently great in this area to cause the near complete flattening of the peaks before the water reaches Test Well 1, or else other influences than the East Landfill is causing the Test Well 1 salinity.

Summary

To summarize my review of data on groundwaters and the effect of the Kaiser East Landfill, I conclude that:

- 1) The salt concentration peaks occurring in the Test well 4 and the Kaiser production well originate from the East Landfill site.
- 2) The groundwater flow is carrying these salts west southwesterly and a portion are detected in Test Well 1.
- 3) Test wells 2 and 3 are not affected and see only groundwater flow from north of the Kaiser plant site.
- 4) Test well 5 also is not affected by water from the East Landfill area.
- 5) Groundwater from the East Landfill area is flowing west southwesterly beneath the rolling mill until it enters the river and/or continues westerly with other aquifer flow through the Spokane Valley.

Addressing your other questions:

- 1) Land use in the pit adjacent to your East Landfill could definitely affect groundwaters in your area. Moisture entering that pit will percolate downwards and to some extent laterally and carry any materials spilled or disposed of in that pit to the aquifer. In addition many gravel bed deposits dip westerly in the Spokane Valley at an angle of about 30°. Percolating water follows these beds, especially those of slightly finer grained material, and could pass beneath your site. This moisture could enter your disposal area if relative elevations permit and could also help "flush" the alluvium below your landfill.

Kaiser should be very cognizant of activities in the adjacent pit and future activities or disposition that may occur.

- 2) There is definitely a likelihood of lateral water movement affecting your site. As I described above, the Spokane Valley alluvium was deposited in layers or beds, some horizontal and some dipping, generally westerly at about 30° from horizontal. Percolating water from adjacent to your landfill could be channeled directly into and through it, especially from the east although the adjacent pit may cut most of that off. Percolating moisture could migrate in from other directions too, through the horizontal or dipping beds.

The beds I refer to here are not impervious, nor are they confined by impervious layers. Instead they are each made up of relatively uniform gravels or sands of a different size from the adjacent bed. Water because of its physical properties, will seek out and follow one size gradation instead of another, thus traveling in directions other than straight down when displaced by additional moisture from above. It may "channel" through beds with gradations less attractive to lateral movement.

- 3) There is a potential for constituents entering the aquifer from Kaiser's Trentwood site impacting groundwater off of your own site and even for impacting groundwater supplies. It appears that groundwaters travelling beneath your site travel west southwesterly, directly toward the granitic intrusion through the alluvium across the river from your plant. These flows may then take one of three escape routes: discharge to the river; pass as groundwater south of the granite intrusion; or pass as groundwater north of the granite intrusion. Those groundwaters diverted south could enter the Modern Electric wells, Washington Water Power District 1 wells, Orchard Avenue Irrigation District wells or City of Spokane wells. Groundwater diverted north could enter Irvin Water District wells, Town of Millwood wells, Pasadena Park wells, Orchard Avenue wells or City of Spokane wells.

Constituents would be more dilute the farther "downstream". The constituents will mix deeper into the aquifer and disperse laterally at a rate of about 250 to 300 feet per mile. This will result in dilution away from the main flow streamline. Flow direction probably doesn't fluctuate greatly although its direction and actual path of constituents isn't pinned down. There may be seasonal fluctuations in constituents entering the aquifer but these fluctuations will be dispersed longitudinally with the aquifer flow until very little seasonal fluctuation is apparent within a few miles downstream.

- 4) I recommend that the test wells and the production well be monitored regularly on at least a twice monthly basis year round to fill in the data gaps in current data. This should start immediately to determine more closely the lag in concentration peaks among wells. Since it appears that the "plume" from the east landfill site is missing test wells 2 and 3 it would appear advisable to construct test wells between 1 and 5 to better delineate constituent travel direction and time. Some additional test drilling in the immediate pit area with soils analysis as you performed on Test Well #7, could assist in delineating the extent of the materials in transit to the aquifer.

Finally, I would like to comment on the "closure" actions possible for the East Landfill. Of course excavating the material and transport off the aquifer would alleviate its affect on water quality. This would be exceedingly expensive and perhaps unwarranted since no hazardous materials are known to be involved. Covering to prevent moisture percolation through the landfilled material may be effective but the extent of cover necessary isn't easily determined and the dispersion of excess moisture accumulating from the site and surrounding area must be given careful thought to prevent its travel laterally and continuation of the problem. Any final site disposition should take into account adjacent areas, especially the adjacent pit.

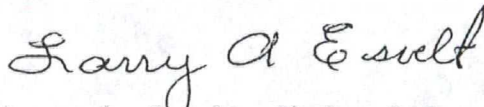
Phil Williams/Larry Esvelt
December 8, 1981

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If you have any questions or comments please call. It has been
a pleasure preparing this analysis for you.

Sincerely yours,

ESVELT ENVIRONMENTAL ENGINEERING

A handwritten signature in cursive script that reads "Larry A. Esvelt". The signature is written in dark ink and is positioned above the typed name.

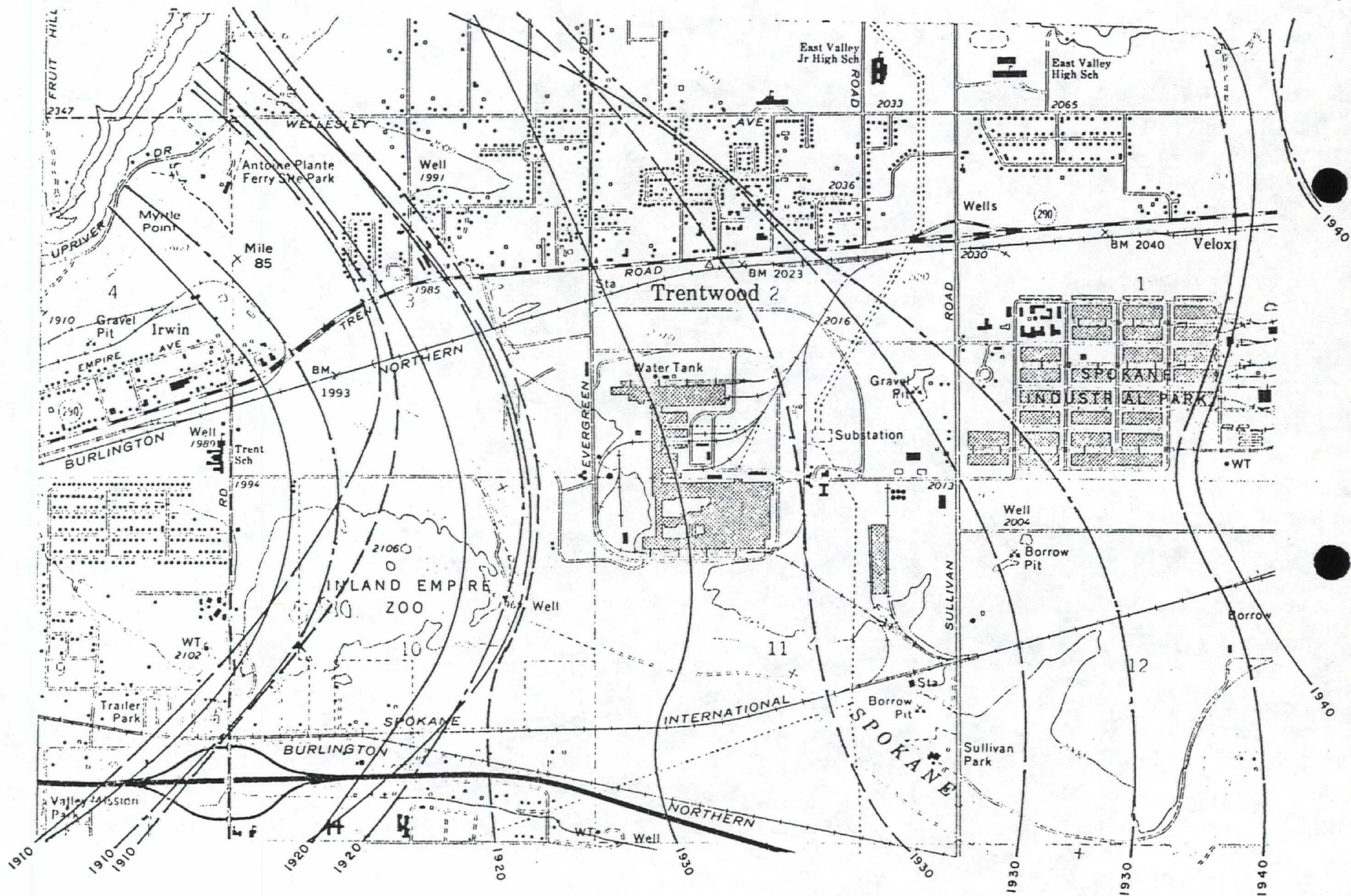
Larry A. Esvelt, Ph.D., P.E.

Enclosures: Figures 25 and 26 from (208) Study-Cause & Effect Report
Maps showing Aquifer Equipotential Lines from USGS, 1977-78.

LAE/vssp

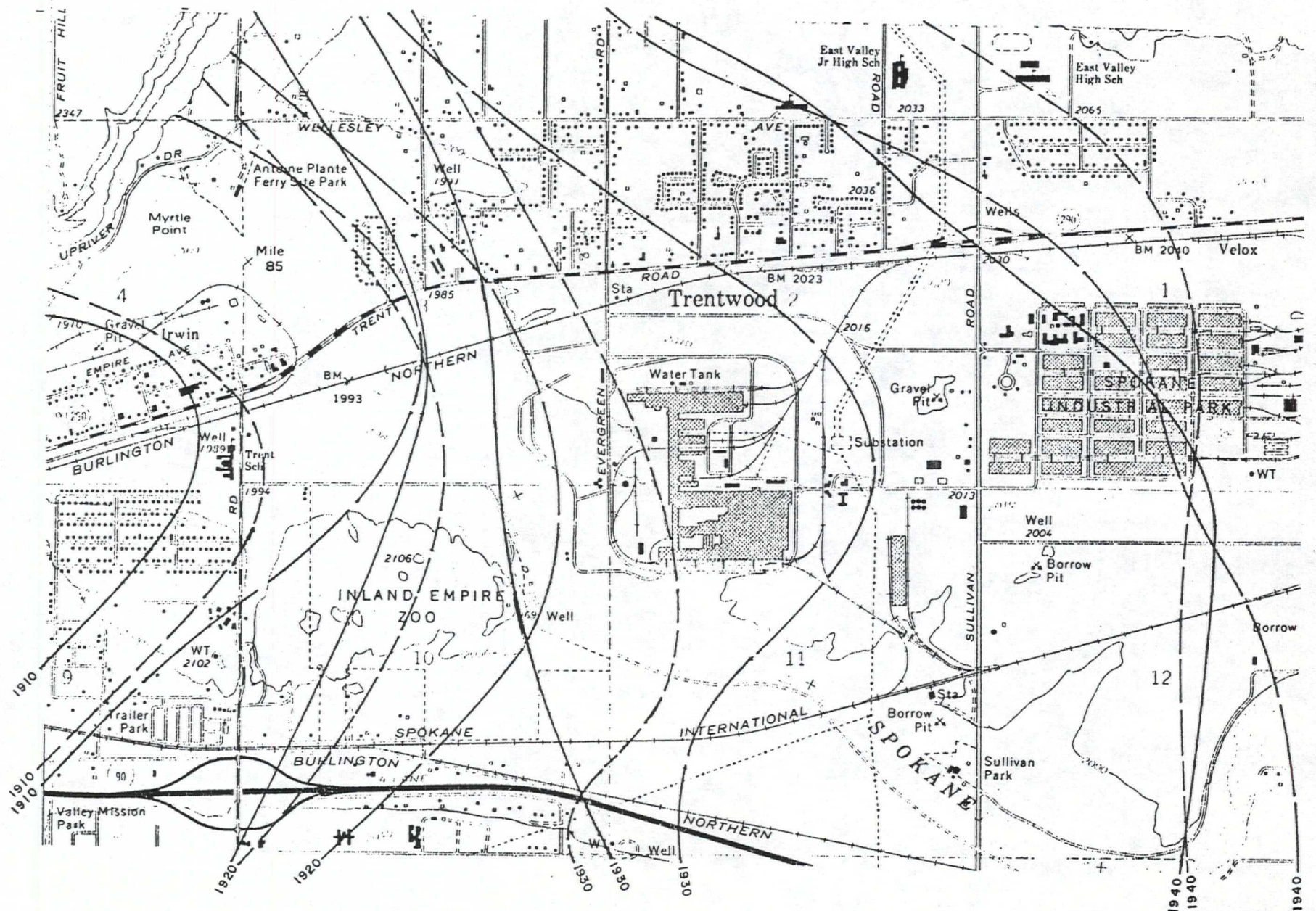
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Mar. 1977 _____
May 1977 _____
Jul. 1977 _____
Oct. 1977 _____



Aquifer Equipotential Lines

Jan. 1978 ———
 Mar. 1978 ———
 May 1978 ———



Aquifer Equipotential Lines

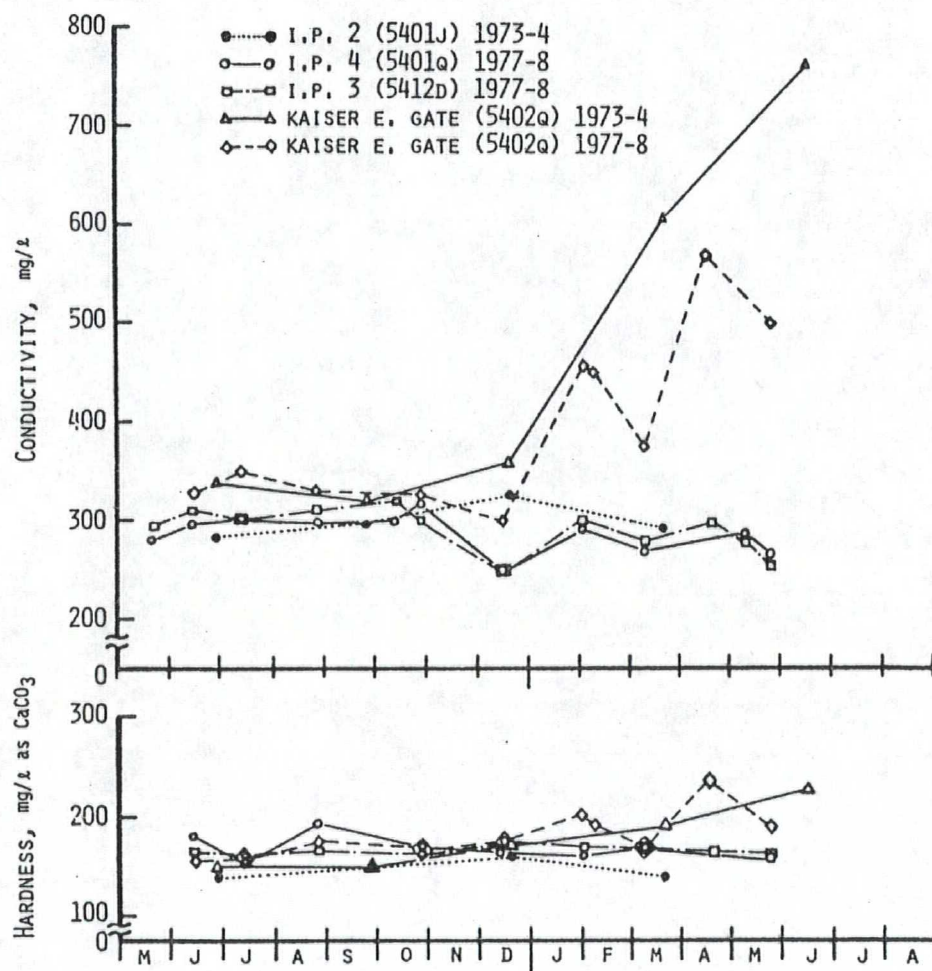


Figure 25. Water quality variations at Industrial Park and Kaiser Trentwood wells-Conductivity and hardness.

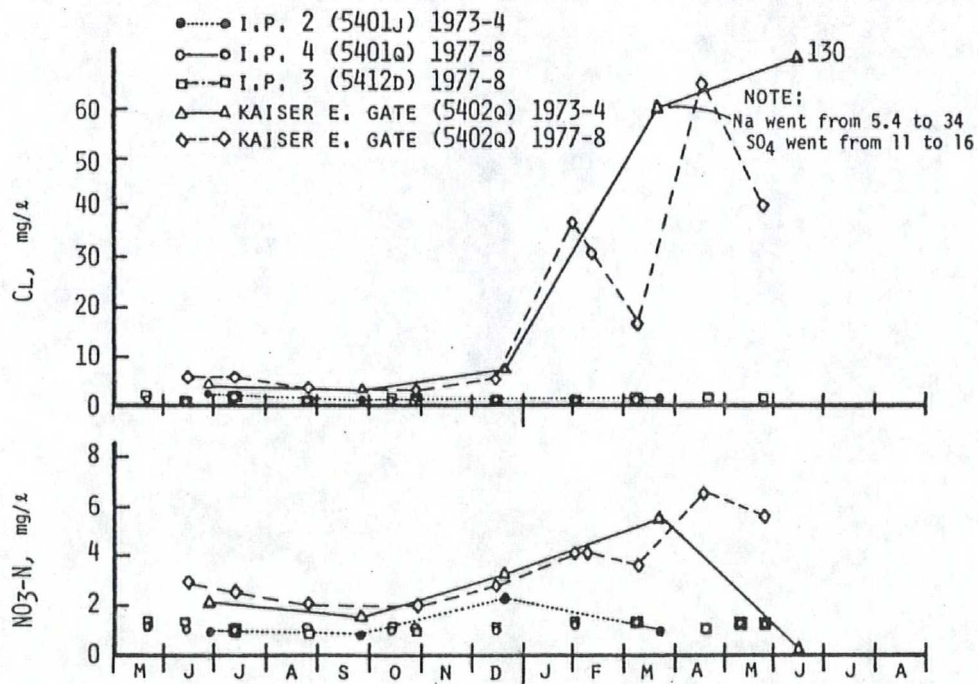


Figure 26. Water quality variations at Industrial Park and Kaiser Trentwood wells-Chlorides and nitrate.